Food Consumption, Activity, and Overweight Among Elementary School Children in an Appalachian Kentucky Community

DEBORAH L. CROOKS*
Department of Anthropology, University of Kentucky, Lexington, Kentucky 40506-0024

KEY WORDS children; growth; diet; Food Guide Pyramid; macronutrients; Kentucky

ABSTRACT In the U.S., child overweight is on the rise and is implicated in later adult chronic illness. Given that overweight is hardly tractable, prevention as compared to treatment is seen as a better alternative for lowering the risk of long-term health consequences. To increase the success of prevention efforts, many argue that programs must be "culturally sensitive" and targeted toward specific populations at greater risk. However, there exists a limited understanding of how overweight is distributed across the landscape, among and within populations and groups. This paper reports the prevalence of overweight among 54 school children in a rural, Appalachian community with a high rate of poverty, and it compares boys to girls. Thirty-seven percent of boys and 10.3% of girls are overweight, based on the 90th percentile body mass index (BMI). Analysis of food intake indicates a pattern of food consumption that is high in fatty and sugary foods and low in fruit and vegetable consumption. Analysis of activity indicates that children report more low-intensity activity than high; that overweight children report more episodes of video/computer play compared to nonoverweight children; and that boys spend more time than girls in front of the computer/television screen. Am J Phys Anthropol 112:159–170, 2000.

Anthropologists have long been interested in describing and understanding variation in child growth. Historically, interest focused on the relationship between genetics and environment in producing variation in stature, body proportion, and body composition among ethnic or geographical groups. Later interests included the role of social and cultural factors in producing variation within and among groups, and the long-term consequences of that variation. Particular attention was paid to the consequences of growth outcome at the lower ends of the distribution, i.e., small body size, and its relationship to cognitive development, immunocompetence, and work capacity.

Currently, anthropologists are becoming increasingly interested in child growth at the higher ends of the distribution, particularly growth in weight, fatness, and body mass. Research from epidemiology and public health indicates that Americans of all ages are becoming heavier and fatter (Division of Health Examination Statistics, National Center for Health Statistics, 1997; Kuczmarski, 1994), and that adult overweight is associated

Grant sponsor: National Institute of Child Health and Human Development, National Institutes of Health Fellowship; Grant number: 5 F32 HD07620; Grant sponsor: University of Kentucky Summer Research Fellowship.

*Correspondence to: Deborah L. Crooks, Department of Anthropology, University of Kentucky, 211 Lafferty Hall, Lexington, KY 40506-0024. E-mail: dlcrooks@pop.uky.edu

Received 31 May 1999; accepted 24 January 2000.

with increasing risk for certain chronic health conditions, e.g., hypertension, coronary heart disease, diabetes mellitus, and some types of cancers (Pi-Sunyer, 1993). In addition, evidence is mounting that child and adolescent obesity are risk factors for certain illnesses and conditions in childhood and adulthood (Dietz, 1998; Must and Strauss, 1999), although the strength and pathways of these relationships are complicated and yet to be fully sorted out (Power et al., 1997; Srinivasan et al., 1996).

Because overweight is implicated in adult chronic illness, public health policy and programs are being directed toward health promotion via weight reduction. Primary areas of focus are 1) improving diet by more closely following the recommendations of the Food Guide Pyramid, USDA, 1992, and 2) including moderate amounts of physical activity in one's daily activities. But despite best efforts, overweight continues to increase among adults and children, as indicated by data from the Third National Health and Nutrition Examination Survey (NHANES III) (Division of Health Examination Statistics NCHS, 1997; Kuczmarski, 1994). As a result, a better understanding of both proximate and distant factors contributing to overweight among the nation's children is of importance. For example, reviews of the literature implicate gender, socioeconomic status, poverty, ethnicity, and even geographical location as important mediators of the relationship between environment and overweight among children (e.g., see Crooks, 1995; Sobol and Stunkard, 1989).

This paper reports on the prevalence of overweight among children in a small, rural community in Appalachian Kentucky. It compares sample children to U.S. reference values for stature, weight, body mass index (BMI), and triceps skinfold thickness, and it compares boys and girls within the sample. Finally, this paper presents information on reported food consumption and activity patterns and tests the hypotheses that these individually contribute to overweight among this sample of children.

METHODS

Community and participants

The research took place at Bridges Elementary School in Bridges County, Kentucky[1] (Crooks, 1998, 1999). The community is in an economically "distressed" area, as designated by the Appalachian Regional Commission.[2] While Bridges County had a high rate of poverty at the time of research (over 25%, with over 35% of the children living in poverty), it is important to note that not all Bridges County families are poor, and the families of the children in this report represent a range of socioeconomic circumstances. However, Bridges Elementary School is located in one of the poorer areas of the county. Children come to Bridges Elementary School, a modern one-story brick school building, from homes in the surrounding hills, hollows, and valleys. In addition, some families from the county seat, located a few miles away, choose to send their children here as well. The school is known for its energetic and caring administrative and teaching staff and consistently wins awards for the quality of its teaching, as reflected in children's scores on statewide standardized examinations and writing portfolios.

The participants in the full research project were 88 children whose parents provided written approval for their participation. Letters were sent home to parents of all children in grades 1–5 (approximately 230). We did not include kindergarten children, since we felt parents might be reluctant to allow these very young children to participate in a research program. We received positive responses from parents of 102 children (approximately 44%), and these constituted our preliminary sample. Children in grades 3–5 (ages 8–12) constituted a secondary sample for additional data collection (children in grades 1 and 2 were excluded from this portion of the research because of the inability of younger children to accurately report dietary data). Over the course of the study, 11 children moved out of the area (9 from the secondary sample), and another 3 were eliminated

[1]Bridges Elementary School and Bridges County are pseudonyms. I take the name from my grandfather, who was also from the mountains.

[2]"Distressed" is an official designation used by the Appalachian Regional Commission to indicate an area of high unemployment and low per capita income.

from analysis due to unreliable data, missing data, or a severe health condition (all from the secondary sample), leaving a sample of 54 children for this portion of the research. The children were all European-American, reflecting the ethnic background of the community; 79.6% of the secondary sample children qualified for free or reduced-price lunch (a measure of poverty; see Crooks (1999) for a definition of this measure and for a description of various socioeconomic and poverty measures among Bridges' families). This number is similar to the 76% reported by the principal for the school as a whole. While it appears, then, that the sample children are representative of the school population at Bridges Elementary School in terms of ethnicity and socioeconomic status, we cannot assume that they are representative of all children in the community, the county, or the Commonwealth of Kentucky in these or other respects.

The data were collected by the author during the 1994–1995 school year and the beginning of the 1995–1996 school year with the help of the Director of the Family Resource Center,[3] following approvals by the University of Kentucky Institutional Review Board and Bridges Elementary School Family Resource Center Advisory Council.

Data collection methods

Anthropometric measures were taken, following standard procedures (see Crooks, 1999). Stature, weight, triceps skinfold thickness, and BMI are reported here, since they are the anthropometric measures most often used to determine overweight. Four 24-hour dietary recalls, spaced to account for day of the week and seasonal variation, provided information on usual food intake. While most children at this age are capable of accurately recalling their food intake for 24 hours, various techniques were employed to assist them (Frank et al., 1977). Food models and posters with pictures of snack foods were particularly helpful in recalling food items; and food models and standard-sized plates, glasses, cups, and lunchroom trays were helpful in recalling portion sizes. Children were asked to think back through the previous 24 hours and to visualize their various activities. Prompts and probes, e.g., "What time did you get up this morning . . . what did you do when you got up . . . what did you do after that?" or "What did you do when you got off the school bus after school . . . what did you do after that?" were helpful, especially for those children who tend to "graze" or snack often, or who might have a glass of orange juice at home before they come to school and then eat breakfast at school.

Following the first 24-hour recall, it was clear that the techniques used to elicit food consumption events would also elicit activity events, and three after-school activity recalls were added to the protocol. For example, responses to "What did you do after you got off the school bus . . .what did you do after that?" would include, "I played ball," "I rode my bike," "I cleaned my room," "I watched TV," among others. Although these data did not provide information on time spent in individual activities, they did provide a general picture of how children spent their time during nonschool hours.

Data analysis

All data were entered into SPSS version 8.0 for Windows (SPSS, Inc., Chicago, IL) for final analysis. Anthropometric data were converted to z-scores, and percentiles were calculated. Reference data for stature and weight were those of the U.S. National Center for Health Statistics (NCHS), and z-scores were first calculated using Anthro software (Centers for Disease Control, Atlanta, GA) before entry into SPSS. Reference data for BMI and triceps skinfold were those of the National Health and Nutrition Examination Surveys (NHANES) I and II (Frisancho, 1990). All means and standard deviations for anthropometric data were calculated separately for boys and girls.

Identifying overweight among children is problematic, and there is no generally accepted definition (Troiano and Flegal, 1999; Troiano et al., 1995). For adults, excess weight is defined relative to associations

[3]Family Resource Centers are funded by the Commonwealth. Their purpose is to act as liaison between community services and poor families; thus, their mandate goes beyond school issues.

with morbidity and mortality (Troiano and Flegal, 1998, 1999). However, because these associations are less clear in children, the definition of overweight is a statistical one, with most researchers choosing the 85th, 90th, or 95th percentiles BMI to indicate overweight (Troiano and Flegal, 1999). Further complicating the issue is the choice of reference or comparison group. While there is consensus that a nationally representative sample is needed for comparison, there is little consensus as to which sample is best because of differences in the size of age- and gender-specific sample groups, use of weighting techniques, and/or smoothing techniques.[4] Two often-used comparison groups are a combined second and third National Health Examination Surveys (NHES II and III), and a combined NHANES I and II. This analysis uses the NHANES I and II data published by Frisancho (1990) because of the large age- and gender-specific groups within the sample.

To identify the prevalence of overweight, children were grouped into categories based on BMI $\geq$90th percentile NHANES values. The 90th percentile was chosen as the cut-point, following the convention of Johnston and Hallock (1994) and Malina (1993). However, it is recognized that other researchers may prefer different cut-points, especially given the recent discussion in the literature over how to define overweight and obesity and which cut-points best identify these two conditions among children (e.g., see Himes, 1999; Troiano and Flegal, 1998, 1999). Therefore, to facilitate comparison with other studies now and in the future, overweight was also calculated as BMI $\geq$85th percentile, BMI $\geq$95th percentile (termed "obesity" by some researchers), and BMI $\geq$85th percentile and $<$95th percentile (when paired with the previous measure, this is termed "overweight" or "at risk for overweight" by some researchers).

[4]Recognizing the problems associated with the various comparison groups, the CDC will provide new growth charts which include BMI in the near future. These will be derived from all NHES and NHANES survey data, with the exclusion of BMI data for age groups $\geq$6 years from NHANES III because of increasing obesity among these age groups (Troiano and Flegal, 1998).

Dietary intake data were initially analyzed via Nutritionist V (First DataBank, Inc., San Bruno, CA). While Nutritionist V reduces foods consumed to a variety of components, this paper reports macronutrients because of their documented relationship with overweight, and food group servings because educational campaigns often utilize the number of recommended food group servings in the Food Guide Pyramid. Data included in the analysis were total kilocalories, the percent of calories from protein, the percent of calories from fat, the percent of calories from saturated fat, the ratio of saturated fat to monounsaturated to polyunsaturated fat, total cholesterol (mg), percent of calories from carbohydrate, total fiber (g), and total refined sugar (g). The six food groups identified in the Food Guide Pyramid and included in the analysis are the Fats, Oils, and Sweets Group (referred to herein as Fats and Sweets Group); the Milk, Yogurt, and Cheese Group (the Milk Group); the Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group (the Meat Group); the Vegetable Group; the Fruit Group; and the Bread, Cereal, Rice, and Pasta Group (the Bread Group). These data were then entered into SPSS, and means and standard deviations were calculated separately for boys and girls.

Activity data were sorted into categories of activities based on low intensity (e.g., watching television or a movie, playing computer games, reading) and high intensity (e.g., riding bikes, swimming, ball practice, cleaning house). Low-intensity activities and high-intensity activities as a percentage of all activities were calculated. Separate categories for video game/computer playing and television/video watching were also created because of extensive interest by researchers and numerous reports in the literature on the relationship between television and overweight. All means and standard deviations were calculated separately for boys and girls.

Differences between boys and girls in categories of overweight were tested via chi-square analysis. *T*-tests were used to test for differences between boys and girls with respect to macronutrient status, food consumption, and activity. *T*-tests also were used to examine deviations from zero for

TABLE 1. Means and standard deviations (in parentheses) of stature, weight, body mass index (BMI), and triceps skinfold thickness, Bridges Elementary School

n			Stature[1]		Weight[2]		BMI[3]		Triceps skin fold[4]	
Age[5]	M	F	Male	Female	Male	Female	Male	Female	Male	Female
8	2	3	132.65 (2.76)	129.23 (10.09)	29.65 (4.03)	25.80 (7.97)	16.91 (3.00)	15.16 (2.22)	12.85 (4.46)	11.1 (5.24)
9	5	6	137.16 (6.19)	135.22 (7.63)	39.74 (12.58)	29.93 (4.47)	20.76 (4.88)	16.32 (1.48)	18.94 (8.18)	12.38 (4.06)
10	6	14	143.13 (7.36)	147.99 (5.83)	40.78 (8.50)	45.06 (10.28)	19.90 (3.97)	20.45 (4.14)	15.83 (6.88)	21.83 (6.04)
11	11	6	146.16 (6.56)	152.52 (4.95)	44.70 (11.61)	42.82 (4.40)	20.69 (4.30)	18.41 (1.64)	17.64 (10.88)	16.60 (2.55)
12	1	0	152.2		61.5		26.55		27.00	

[1] Stature is in cm.
[2] Weight is in kg.
[3] BMI $= \frac{\textit{weight in k}}{\textit{stature in } m^2}$.
[4] Triceps skinfold is in mm.
[5] Age is in years.

TABLE 2. Means and standard deviations (in parentheses) for stature (HAZ) and weight (WAZ) z-scores, NCHS references; and BMI (BMIZ) and triceps skinfold thickness (TRICEPZ) z-scores, NHANES references

n			HAZ		WAZ		BMIZ		TRICEPZ	
Age	M	F	Male	Female	Male	Female	Male	Female	Male	Female
8	2	3	0.25 (0.66)	−0.05 (1.28)	0.33 (0.63)	−0.50 (1.36)	0.28 (1.36)	−0.49 (0.82)	0.73 (1.01)	−0.18 (0.97)
9	5	6	0.38 (0.95)	−0.01 (1.19)	1.40† (1.96)	−0.23† (0.77)	1.61*† (2.03)	−0.32*† (0.48)	1.71*† (1.61)	−0.17*† (0.69)
10	6	14	0.45 (1.21)	1.02*** (0.71)	0.92 (1.26)	1.14*** (1.25)	0.79 (1.42)	0.89** (1.34)	0.76 (1.20)	1.30*** (0.99)
11	11	6	0.01 (0.88)	0.67* (0.73)	0.69 (1.42)	0.35** (0.38)	0.64† (1.20)	−0.13† (0.43)	0.73 (1.55)	0.24 (0.38)
12	1	0	0.08		1.95		2.19		2.18	

† Indicates significant differences between boys and girls at $P < 0.10$.
* Indicates significant difference from zero at $P \leq 0.10$.
** Indicates significant difference from zero at $P \leq 0.05$.
*** Indicates significant difference from zero at $P \leq 0.01$.

anthropometric z-scores, and deviations from recommendations for food group servings consumed (based on the Food Guide Pyramid) and macronutrient status. Since food group servings are given in ranges, and since we are dealing with children rather than adults, the test variable for deviations from recommendation was the lowest number recommended (i.e., 2 for the Meat Group, 3 for the Vegetable Group, 2 for the Fruit Group, and 6 for the Bread Group), except for the Milk Group. Given that children generally require higher levels of calcium for their size than adults, that test statistic was set at 3. Finally, t-tests also examined the relationship between food group servings and overweight, and activity and overweight.

RESULTS

Growth and nutritional status

Table 1 presents the mean stature, weight, body mass index, and triceps skinfold by age for boys and girls. Table 2 presents these same anthropometic categories, but as mean z-scores. There is a tendency for boys' z-scores to differ from zero in a positive direction for the BMI (BMIZ) and triceps skinfold thickness (TRICEPZ) at age 9. Girls tend to differ in a negative direction for BMIZ and TRICEPZ at age 9, and in a positive direction for height (HAZ) and a negative direction for BMI at age 11. Girls differ significantly in a positive direction from zero for all z-scores at age 10, and for weight (WAZ) at age 11. There is a tendency for boys and girls to differ from each other at age 9 for WAZ, BMIZ, and TRICEPZ and at age 11 for BMIZ, with boys having greater values compared to girls.

Table 3 provides information on overweight. As can be seen, regardless of the measure or cut-point used, a greater percentage of sample children than reference children are overweight, with far more boys compared to girls. Differences between boys and girls are significant when using the 85th and 90th percentiles as cut-points for overweight. Figure 1, which utilizes the 90th percentile as the cut-point, confirms that most of the overweight occurs among boys in the 9–11-year-old age groups; and that only 10-year-old girls exhibit overweight.

TABLE 3. Distribution of sample children who are overweight by various BMI percentile cut-points, NHANES I and II reference values

	Boys (n = 25)		Girls (n = 29)		Both (n = 54)	
	n	%	n	%	n	%
BMI ≥95	7	28.0	3	10.3	10	18.5
BMI ≥85 and <95	5	20.0	3	10.3	8	14.8
BMI ≥90	9	36.0*	3	10.3*	12	22.2
BMI ≥85	12	48.0**	6	20.7**	18	33.3

* Differences between boys and girls significant by Fisher's exact test, chi-square = 5.11, $P = 0.026$.
** Differences between boys and girls significant by Fisher's exact test, chi-square = 4.51, $P = 0.045$.

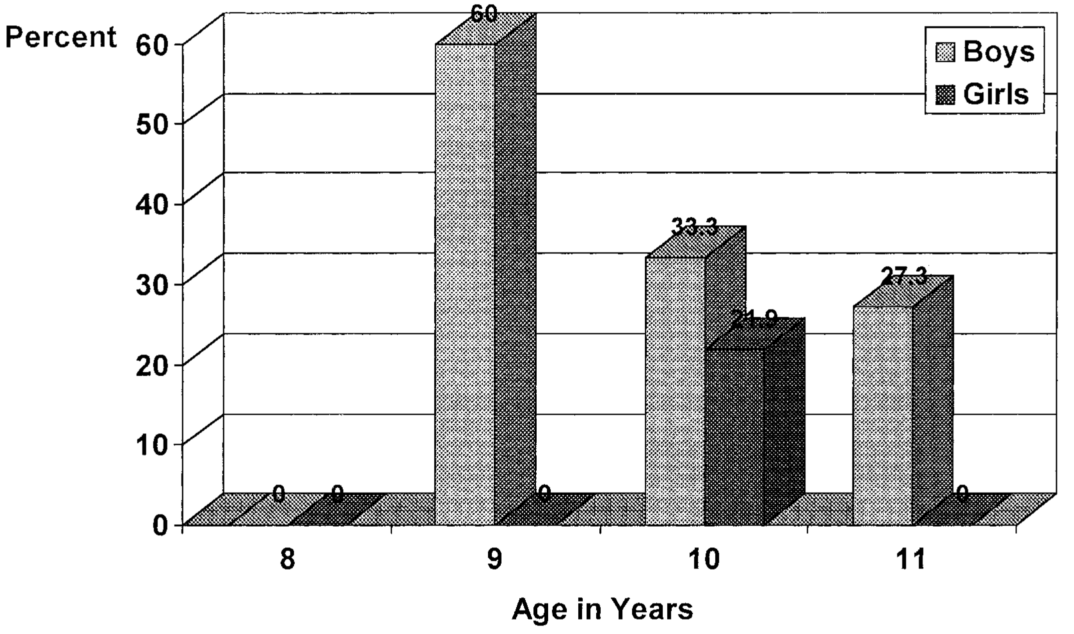

Fig. 1. Percent of sample boys and girls who are overweight by age. Overweight is defined as ≥≥90th percentile, NHANES I and II reference data.

Macronutrient and food consumption patterns

Table 4 presents the mean consumption of macronutrients for sample children, and boys and girls separately. The average recommended kilocalorie consumption for this age group is 2,000. Neither boys nor girls deviate significantly from this number, nor is the difference between boys and girls statistically significant. Recommendations for a healthy diet are 15% of kilocalories from protein, 55% from carbohydrate, and 30% from fat. At 13.46% kilocalories from protein, Bridges children deviate in a negative direction from the recommendation. At 36.31% kilocalories from fat, Bridges children deviate in a positive direction, with girls having a small, but significantly higher consumption of calories from fat than boys. Children are also consuming significantly more calories from saturated fat than recommended; this is also reflected in a highly skewed fat ratio, with significantly higher consumption of saturated fat and monounsaturated fat and significantly lower consumption of polyunsaturated fat than recommended (the recommendation is equal portions of the three types). Interestingly, the children's average consumption of cholesterol is less than recommended, but this is due to a much lower consumption of cholesterol by girls, i.e., the boys' deviation from the recommendation is not significant.

With respect to carbohydrates, both boys and girls are consuming significantly less than the recommended 55% of calories from

TABLE 4. Means and standard deviations (in parentheses) for macronutrients for sample children compared to recommendations

Macronutrients and recommended averages for children		Sample children	Boys only	Girls only	Difference between boys and girls
Kilocalories	2,000	2,068.12 (575.35)	2,171.37 (518.62)	1,979.10 (615.08)	$P = 0.22$
Calories from protein (%)	15	13.46** (1.89)	13.64** (1.75)	13.31** (2.02)	$P = 0.53$
Calories from fat (%)	30	36.31** (3.73)	35.29** (3.46)	37.28** (3.74)	$P = 0.04$
Calories from saturated fat (%)	10	13.12** (2.21)	12.85** (2.10)	13.34** (2.31)	$P = 0.42$
Fat ratio (%) (saturated/monounsaturated/polyunsaturated)	1/3:1/3:1/3	42:39:19**	43:39:18**	42:39:20**	$P = 0.56/0.58/0.75$
Cholesterol (mg)	300	256.53* (121.47)	272.19 (137.45)	243.04* (106.46)	$P = 0.38$
Calories from carbohydrate (%)	55–60	51.83** (4.77)	52.48* (4.79)	51.28** (4.76)	$P = 0.36$
Fiber (10–13 g/1,000 kcal)	25	12.43** (8.74)	11.69** (3.67)	13.06** (11.49)	$P = 0.57$
Refined sugar (g)	Moderate	120.53 (40.86)	127.64 (41.18)	114.40 (40.29)	$P = 0.24$

* Differs significantly from recommendation by $P \leq 0.01$.
** Differs significantly from recommendation by $P \leq 0.001$.

TABLE 5. Means and standard deviations (in parentheses) for food group servings for sample children compared to recommendations in the Food Guide Pyramid

Food group servings in Food Guide Pyramid		Sample children	Boys only	Girls only	Difference between boys and girls
Fat and sweets group	Sparingly	23.53 (10.55)	24.84 (9.97)	22.41 (11.08)	$P = 0.40$
Milk group	2–3	2.57 (1.44)	2.62 (1.20)	2.53 (1.64)	$P = 0.83$
Meat group	2–3	1.80* (0.63)	1.92 (0.60)	1.69* (0.64)	$P = 0.18$
Vegetable group	3–5	1.80*** (0.94)	1.80*** (0.87)	1.79*** (1.01)	$P = 0.98$
Fruit group	2–3	0.93*** (0.98)	0.96*** (1.13)	0.91*** (0.85)	$P = 0.84$
Bread group	6–11	5.49* (1.73)	6.10 (1.77)	4.97*** (1.55)	$P = 0.02$

* Differs significantly at $P \leq 0.05$.
** Differs significantly at $P \leq 0.01$.
*** Differs significantly at $P \leq 0.001$.

carbohydrates. In addition, children are consuming significantly less than the recommended amount of fiber by about half. Both boys and girls are consuming extremely high amounts of refined sugar. Since the recommendation for consumption of refined sugar is "moderate," i.e., not a number, deviation from recommendation could not be tested. However, the average daily consumption for the sample children is 120 g, which is equivalent to 10 tablespoons. At 45 kilocalories per tablespoon, 22.5% of total energy is being supplied by sugar, representing almost one half of the recommended energy from carbohydrates. This is well above "moderate" consumption.

Analysis of food consumption by food group servings (Table 5) reflects the high fat and sugar, low fiber consumption indicated above. Again, the Recommended Daily Allowances (RDA) recommendation that fats, oils, and sweets should be consumed "sparingly" precludes a statistical analysis of deviation from recommendation. However, given that the average daily consumption from this food group is over 23 servings, clearly the sample children are deviating from the recommendation. Children are consuming significantly fewer fruits and vegetables than recommended, with little difference between boys and girls. Boys' consumption of foods from the Meat Group and the Bread Group appear close to recommendations, but girls are consuming significantly fewer of these foods than recommended. Differences between boys and girls, while not significant for the Meat Group, are significant for the Bread Group. The only food group which indicates ade-

TABLE 6. *Mean reported activity episodes and standard deviations (in parentheses) for nonschool-associated activity*

Activity	Boys Mean	Boys SD	Girls Mean	Girls SD	Difference between boys and girls, *P*-value
Low-intensity activities	4.76	(2.03)	5.62	(2.04)	0.13
High-intensity activities	3.76	(2.09)	2.90	(1.61)	0.09
Percent low-intensity activity	56.36	(21.06)	66.04	(15.72)	0.06
Percent high-intensity activity	43.64	(21.06)	33.96	(15.72)	0.06
Video/computer play	0.68	(1.03)	0.41	(0.87)	0.31
Television/movie watching	2.28	(1.14)	2.24	(1.48)	0.92

TABLE 7. *Mean food consumption and standard deviations (in parentheses) for nonoverweight and overweight children*[1]

Food group servings	Nonoverweight Mean	Nonoverweight SD	Overweight Mean	Overweight SD	*P*-value
Fats and sweets group	22.17	(9.33)	28.29	(13.43)	0.07
Milk group	2.71	(1.54)	2.10	(0.91)	0.20
Meat group	1.74	(0.67)	1.98	(0.43)	0.26
Vegetable group	1.79	(1.01)	1.83	(0.69)	0.88
Fruit group	1.02	(0.60)	0.60	(0.61)	0.19
Bread group	5.32	(1.75)	6.08	(1.60)	0.18

[1] Children are considered "overweight" at BMI ≥90th percentile, NHANES I and II.

TABLE 8. *Mean reported activities and standard deviations (in parentheses) for nonoverweight and overweight children*[1]

Activity	Nonoverweight Mean	Nonoverweight SD	Overweight Mean	Overweight SD	*P*-value
Video/computer play	0.33	(0.72)	1.25	(1.29)	0.03
Television/movie watching	2.24	(1.43)	2.33	(0.89)	0.83
Low-intensity activity	5.29	(2.14)	5.00	(1.81)	0.68
High-intensity activity	3.36	(2.00)	3.08	(1.44)	0.66
Percent low-intensity activity	61.6	(19.4)	61.3	(17.6)	0.68
Percent high-intensity activity	38.4	(19.4)	38.7	(17.6)	0.66

[1] Children are considered "overweight" at BMI ≥90th percentile, NHANES I and II.

quate or appropriate consumption is the Milk Group, with both boys and girls consuming adequate servings.

Activity patterns

Table 6 indicates the types of after-school and weekend activities that children report. These include more episodes of low-intensity activities compared to high-intensity activities (differences between high and low are significant at $P \leq 0.05$ for boys and $P \leq 0.001$ for girls). In addition, there are significant gender differences in reported activities in that boys report more high-intensity activities than girls, with a greater proportion of high-intensity activities in their overall activity pattern. Conversely, girls report a higher proportion of low-intensity activities in their overall activity pattern compared to boys. Although there are no significant differences between boys and girls vis-à-vis reported episodes of video/computer play and/or television/movie watching, for boys these categories combined account for 62% of their low-intensity activities, while for girls they account for 48%, significantly different at $P \leq 0.05$.

Relationship between food intake, activity, and overweight

Tables 7 and 8 provide data on differences in food consumption and activity patterns between overweight and nonoverweight children. Since only 3 girls were classified as overweight, data for boys and girls were combined for this part of the analysis. With respect to foods consumed (Table 7), overweight children consume more servings

from the Fats and Sweets Group (28.29 vs. 22.17, $P = 0.07$). No other food group approached significance, although overweight children appear to consume fewer fruits compared to nonoverweight children. With respect to activity, the only significant difference between overweight and nonoverweight children is in the number of reported episodes of video/computer play, overweight children reporting significantly more episodes (1.25 vs. 0.33, $P = 0.03$).

DISCUSSION

Child overweight is a problem of concern in the U.S.; however, this complex phenomena is only minimally understood (Bandini and Dietz, 1992; Power et al., 1997). Large-scale health and nutritional studies indicate that child overweight is increasing (Division of Health Examination Statistics, National Center for Health Statistics, 1997; Mei et al., 1998; Ogden et al., 1997) and requires our attention as a nation because of its possible connection to later adult chronic health problems. At the same time, the complexity of the problem belies aggregate measures and simple solutions, and many experts are calling for local-level research on which to base community prevention efforts (e.g., Melnik et al., 1998a,b).

The research reported here focuses on school children in a rural community in a part of the country that is historically underserved by health research and health care, and in which morbidity, mortality, and disability from adult chronic illness is extremely high. Given this, the pattern of growth among these 3rd–5th grade school children is especially disconcerting. Although the pattern of growth among this study sample is more variable for girls than boys, both sample groups exhibit z-scores by age that exceed reference values for some anthropometric measures. However, while 9 out of 25 boys are overweight (36%), only 3 out of 29 (10.3%) girls are overweight, i.e., the burden of overweight among the Bridges sample falls mostly on boys.[5]

Direct comparisons between the Bridges sample and samples from other U.S. community-based studies where high rates of overweight tend to prevail are made difficult by the various overweight criteria and reference samples used in the research. Nevertheless, a brief review of some of this research will serve to contextualize the Bridges data with respect to other communities. Malina (1993) analyzed data from a number of studies, reporting "obesity" levels of 17.6% for urban Indian boys, 14.0% for urban white boys, 10.3% for reservation Indian boys, 9.0 for rural white boys, 7.7% for urban black boys, and 4.6% for Mexican American boys, based on the 90th percentile BMI from NHANES I. He reports obesity levels of 11.2% for urban black girls, 7.9% for urban white girls, 6.6% for Mexican-American girls, 6.4% for urban Indian girls, 6.2% for rural white girls, and 5.5% for reservation Indian girls. Okamoto et al. (1993), working with primarily black and Hispanic children in Harlem, report 13.6% of boys and 13.9% of girls at >95th percentile weight-for-height of the National Center for Health Statistics (NCHS) reference values. Working with first grade children from high- and low-poverty areas in rural Washington, Sherry et al. (1992) report rates of "obesity," based on the 90th percentile weight-for-height of the NCHS growth charts, and "superobesity," based on the 95th percentile, as 12% "obese" and 6% "superobese" for children from high-poverty areas. They report rates of 18% "obese" and 14% "superobese" from low-poverty areas. Melnik et al. (1998b), using NHES Cycle II and III references, report 40% of second grade New York City school boys at ≥85th and 22.7 % at ≥95th percentiles BMI, with 34.3% of fifth grade boys at ≥85th and 21.8% at ≥95th percentiles BMI. They report rates of overweight for second grade girls as 35.2% at ≥85th and 17.3 at ≥95th percentiles BMI, with fifth grade girls at 29.6% at ≥85th and 14.6% at ≥95th percentiles BMI. Johnston and Hallock (1994), using the 90th percentile of NHANES I and II, report overweight among older urban black youth (ages 11–15) as 20% for boys and 12% for girls. Gordon-Larsen et al. (1997), using the 95th percentile BMI from NHANES I as

[5]Interestingly, the anthropometric analysis which included all children participating in the research indicated that stunting is most prevalent among girls at the youngest end of the age range (see Crooks, 1999).

reference, report overweight among older urban black youth (ages 11–15) as 17.0% for boys and 18% for girls.

Taken together, the research reported above indicates that child and later adolescent overweight is not a homogeneous phenomenon in the U.S., and differences among groups may exist due to circumstances of place (rural vs. urban), age, ethnicity, and gender. Focusing locally, we can ask the question, "What might explain the high rates of overweight for the children from Bridges Elementary School?" The 24-hr recalls indicate children are not meeting the dietary guidelines for certain foods and therefore, their dietary status is questionable and nutritional status is compromised. In terms of dietary quality, children are consuming more calories from fat than recommended, and fewer from protein and carbohydrates. Almost one half of the calories consumed from carbohydrates are from sugar rather than complex carbohydrates. This reflects the pattern reported for U.S. children in general, i.e., a high consumption of sugary and fatty foods, with low fruit and vegetable consumption (Kennedy and Goldberg, 1995, Munoz et al., 1997). The "traditional" high-fat American diet is reflected in this eating pattern, and is particularly entrenched in the South and perhaps among poor and rural populations as well (Beardsworth and Keil, 1997; Johnson et al., 1994; Pillsbury, 1998). This dietary pattern, along with preparation techniques that stress fats and oils, may be particularly slow to change in certain groups due to cultural ideology, identity issues, and other social and cultural factors. Observations in the school lunchroom and discussions with key informants indicate preferences for frying as a method of food preparation and the importance of biscuits, gravy, fried chicken, etc., as culturally valued foods. In addition, sugary foods, particularly candy and soda pop, are probably replacing more healthful foods in the diets of these Bridges children, adding further to poor dietary quality. Why children choose to consume candy and pop over other foods is a question that remains to be asked here. Sylvester et al. (1995) suggest a connection between an increasing proliferation of high-sugar foods and marketing schemes that directly target children. This indicates a potentially fruitful path for future research on understanding why children eat what they do.

In addition to food consumption, activity appears to play a role in overweight among Bridges children. The relationship between physical activity and nutritional status among children was recently reviewed by Dufour (1997). She reports that, although research is somewhat inconsistent, boys tend to be more physically active than girls, and low activity may be indicated in obesity. The findings of Dufour (1997) are supported by this research. Boys engage in more high-intensity activities than girls, and there is some indication that activity in the form of video/computer play is associated with overweight among Bridges children as well. Recognizing that the activity data do not account for time spent in certain activities, Bridges children report more instances of low-intensity activities than high-intensity activities; and overweight children report significantly more instances of video/computer play compared to nonoverweight children. Contrary to some of the literature, television/movie watching did not factor into overweight; however, research is inconsistent with respect to this relationship, some indicating a dose-response relationship (e.g., Gortmaker et al., 1996), while others indicate no relationship (e.g., Robinson et al., 1993). Without time spent in individual activities, it is difficult to interpret the Bridges data. However, if we assume similar patterns of television watching for overweight and nonoverweight children, then we can hypothesize that, television aside, video/computer play is displacing other more active forms of play for overweight children. The almost counterintuitive finding that boys, who are more likely to be overweight than girls, are also more likely to engage in high-intensity activity, may also be a function of time spent in particular activities. That is, instances of high-intensity activities for boys may be of extremely short duration, or the additional kilocalorie consumption of boys compared to girls, although not statistically significant, may outweigh any benefit gained from more high-intensity activities. In addition, since

boys report a higher combined video/computer and television/movie watching activity rate, it is clear that boys are turning to the screen more often than girls for entertainment.

This research provides information on patterns of growth, nutritional status, food consumption, and activity among boys and girls in a rural community with a high rate of poverty. In the U.S., "rural" is often conflated with "agricultural," and often brings to mind idealized images of "healthy" food from home gardens and lots of outdoor play for rural children. At the same time, stereotypical images of Appalachia often center on hungry, wasted children with few of the "luxuries" of life. Instead, this research indicates that the children of Bridges Elementary School are little different from their counterparts in other U.S. places, at least with respect to food consumption and activity patterns. While there is a higher prevalence of overweight, particularly among boys, compared to U.S. children in general or among other at-risk populations, these sample children, like other U.S. children, are not eating healthily: they are not meeting the dietary guidelines with respect to consumption of foods from 5 of the 6 food groups. In addition, they may be spending too much time in front of the video/computer screen at the expense of more active forms of recreation. Kennedy and Goldberg (1995, p. 122) argue that "reducing childhood obesity requires a dual strategy of a healthful diet and increased physical activity." This will require a clearer understanding of why various children in local communities exhibit the particular eating and activity patterns they do. Johnston and Hallock (1994) point to economic disadvantage as a possible contributor to poor nutritional status; Melnik et al. (1998b) indicate that ethnicity may play a role; and this research indicates that place and gender may be issues as well. Continued efforts to identify the pattern of nutritional status among children in the U.S., followed by research aimed at understanding those patterns, will contribute much to the "culturally sensitive prevention efforts" currently seen as necessary to reducing the risk of long-term chronic illness in the U.S. (Melnik et al., 1998a, p. 983).

ACKNOWLEDGMENTS

This research would not have been possible without the help of my colleague, the Director of the Family Resource Center at Bridges Elementary School. My thanks go to her, and to the principal, teachers, staff, and parents. A very special thank you goes to the children who gave their time, their bodies, their voices, and their opinions to the project. As always, the advice and guidance of Sara A. Quandt is highly appreciated, as are the very helpful comments of two anonymous reviewers of the manuscript.

LITERATURE CITED

Bandini LG, Dietz WH. 1992. Myths about childhood obesity. Pediatr Ann 21:647–652.

Beardsworth A, Keil T. 1997. Sociology on the menu: an invitation to the study of food and society. London and New York: Routledge Press. 227 p.

Crooks DL. 1995. American children at risk: poverty and its consequences for children's health, growth, and school achievement. Yrbk Phys Anthropol 38:57–86.

Crooks DL. 1998. Poverty and nutrition in eastern Kentucky: the political-economy of childhood growth. In: Goodman A, Leatherman T, editors. Building a new biocultural synthesis: political-economic perspectives on human biology. Ann Arbor: University of Michigan Press. p 339–355.

Crooks DL. 1999. Child growth and nutritional status in a high-poverty community in eastern Kentucky. Am J Phys Anthropol 109:129–142.

Dietz WH. 1998. Health consequences of obesity in youth: childhood predictors of adult disease. Pediatrics 101:518–525.

Division of Health Examination Statistics, National Center for Health Statistics. 1997. Update: prevalence of overweight among children, adolescents, and adults—United States, 1988–1994. MMWR 46:199–202.

Dufour DL. 1997. Nutrition, activity, and health in children. Annu Rev Anthropol 26:541–565.

Frank GC, Berenson GS, Schilling PE, Moore MC. 1977. Adapting the 24-hr recall for epidemiologic studies of school children. J Am Diet Assoc 71:26–31.

Frisancho AR. 1990. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor: University of Michigan Press. 189 p.

Gordon-Larsen P, Zemel BS, Johnston FE. 1997. Secular changes in stature, weight, fatness, overweight, and obesity in urban African-American adolescents from the mid-1950s to the mid-1990s. Am J Hum Biol 9:675–688.

Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. 1996. Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. Arch Pediatr Adolesc Med 150: 356–362.

Himes JH. 1999. Agreement among anthropometric indicators identifying the fattest adolescents. Int J Obes [Suppl] 23:18–21.

Johnson RK, Guthrie H, Smiciklas-Wright H, Wang MQ. 1994. Characterizing nutrient intakes of chil-

dren by sociodemographic factors. Public Health Rep 109:414–420.
Johnston FE, Hallock RJ. 1994. Physical growth, nutritional status, and dietary intake of African-American middle school students from Philadelphia. Am J Hum Biol 6:741–747.
Kennedy E, Goldberg J. 1995. What are American children eating? Implications for public policy. Nutr Rev 53:111–126.
Kuczmarski RJ. 1994. Increasing prevalence of overweight among US adults: the National Health and Nutrition Examination Surveys, 1960 to 1991. JAMA 272:205–211.
Malina RM. 1993. Ethnic variation in the prevalence of obesity in North American children and youth. CRC Crit Rev Food Sci Nutr 33:389–396.
Mei Z, Scanlon KS, Grummer-Strawn LM, Freedman DS, Yip R, Trowbridge FL. 1998. Increasing prevalence of overweight among US low-income preschool children: the Centers for Disease Control and prevention pediatric nutrition surveillance, 1983 to 1995. Pediatrics 101:12.
Melnik TA, Jesaitis AT, Wales KR, Bonam SB. 1998a. Prevalence of overweight among third- and six-grade children—New York City, 1995. Editorial note. MMWR 47:980–984.
Melnik TA, Rhoades SJ, Wales KR, Cowell C, Wolfe WS. 1998b. Overweight school children in New York City: prevalence estimates and characteristics. Int J Obes 22:7–13.
Munoz KA, Krebs-Smith S, Ballard-Barbash R, Cleveland LE. 1997. Food intakes of U.S. children and adults compared with recommendations. Pediatrics 100:323–329.
Must A, Strauss RS. 1999. Risks and consequences of childhood and adolescent obesity. Int J Obes [Suppl] 23:2–11.
Ogden CL, Troiano RP, Briefel RR, Kuczmarski RJ, Flegal KM, Johnson CL. 1997. Prevalence of overweight among preschool children in the United States, 1971 through 1994. Pediatrics 99:1.
Okamoto E, Davidson LL, Conner DR. 1993. High prevalence of overweight in inner-city schoolchildren. Am J Dis Child 147:155–159.
Pillsbury R. 1998. No foreign food: the American diet in time and place. Boulder: Westview Press. 161 p.
Pi-Sunyer FX. 1993. Medical hazards of obesity. Ann Intern Med 119:655–660.
Power C, Lake JK, Cole TJ. 1997. Measurement and long-term health risks of child and adolescent fatness. Int J Obes Relat Metab Disord 21:7–13.
Robinson TN, Hammer LD, Killen JD, Kraemer HC, Wilson DM, Hayward C, Taylor CB. 1993. Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analyses among adolescent girls. Pediatrics 91:273–280.
Sherry B, Springer DA, Connell FA, Garrett SM. 1992. Short, thin, or obese? Comparing growth indexes of children from high- and low-poverty areas. J Am Diet Assoc 92:1092–1095.
Sobol J, Stunkard AJ. 1989. Socioeconomic status and obesity: a review of the literature. Psychol Bull 105: 260–275.
Srinivasan SR, Bao W, Wattigney WA, Berenson GS. 1996. Adolescent overweight is associated with adult overweight and related multiple cardiovascular risk factors: The Bogalusa Heart Study. Metabolism 45: 235–240.
Sylvester GP, Achterberg C, Williams J. 1995. Children's television and nutrition: friends or foes? Nutr Today 30:6–15.
Troiano RP, Flegal KM. 1998. Overweight children and adolescents: description, epidemiology, and demographics. Pediatrics 101:497–504.
Troiano RP, Flegal KM. 1999. Overweight prevalence among youth in the United States: why so many different numbers? Intl J Obes [Suppl] 23:22–27.
Troiano RP, Flegal KM, Kuczmarski RJ, Campbell SM, Johnson CL. 1995. Overweight prevalence and trends for children and adolescents: the National Health and Nutrition Examination Surveys, 1963 to 1991. Arch Pediatr Adolesc Med 149:1085–1091.
United States Department of Agriculture. 1992. The food guide pyramid. Home and garden bulletin no. 252. Hyattsville, MD: Human Nutrition Information Service.